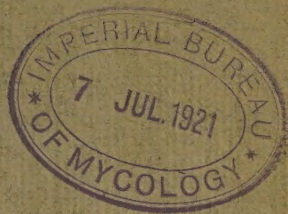
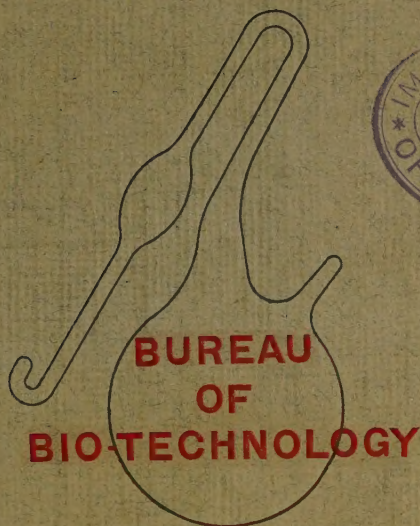

BULLETIN No. 3

□ JUNE 1st, 1921 □



THE BUREAU OF BIO-TECHNOLOGY

THE BIOLOGICAL RESEARCH
:: :: DEPARTMENT OF :: ::
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□ LONDON, LEEDS □
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FOREWORD

IT has been our object in previous issues of the *Bulletin*, by avoiding both a style too popular and a treatment too scientific, to appeal not only to the expert but also to the less advanced reader interested in the progress of technology. The inclusion of the first article in the present issue may be justified on grounds of the growing importance of the question of hydrogen ion concentration in science and industry, and the simple method outlined as having been usefully applied in our own laboratory will possibly prove useful, or at anyrate suggestive, to others.

The mycological article was suggested by our own endeavours, and those of new students, to find a proper basis upon which to build further systematic work. We hope that, by collecting and commenting upon existing literature on the subject, we may have helped to establish a definite starting point for future much-needed investigation upon the Mycology of Leather Manufacture.

Numerous enquiries have been received regarding subscription to the *Bulletin*: we are gratified by this fact, and are giving the matter attention. It is believed that a small charge to defray a portion of the cost of production would continue to be justified by the contents, and that such a charge, if made, would not be met unwillingly by those who have encouraged us to contemplate a larger circulation.

June 1st, 1921.

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A Method of Determining Hydrogen Ion Concentration,

AND THE RELATIONSHIP BETWEEN pH AND ACID TASTE

THE factor of Hydrogen Ion Concentration, the methods of its determination, and its influence upon fermentation processes, continually claims further attention. The pioneer work of Sørensen, Walpole, Clark, Lubs and others has been productive of remarkable developments in the comparatively short time which has elapsed since that work was first begun. There are now established methods for expressing the hydrogen ion concentration (H.I.C.) which recommend themselves to the routine laboratory worker. The intricacy and expense, as well as the somewhat specialised knowledge of physical chemistry and mathematics, involved in the electrometric method of determining the H.I.C., precludes that method from general use. This applies, to a lesser degree, to the method of employing buffer solutions. These considerations appear to justify the adoption of an empirical procedure which will provide relatively accurate data by simple means.

Such a method has been worked out by L. S. Medalia, and after a fairly comprehensive trial has been found useful in these laboratories for the study of acidity of wort and beers. There is no doubt that when this method is employed with reasonable

care results of a sufficiently high degree of accuracy are obtained for all practical purposes, *i.e.*, adjustment of bacteriological media, acidity of wort, acidity developed in fermentation. The procedure consists of comparing the colour produced by an indicator in the fluid under examination, with the intermediate colours occurring when that indicator changes from its extreme acid to its extreme alkaline indication. Having regard to the pH range of the indicator, the intermediate points of the colour change will represent intermediate pH values.

The indicators invented by Clark and Lubs (1916) are now in general use, and easily obtainable. Each of these indicators undergoes a distinct and obvious colour change through its particular range of pH values.

In the method of employing buffer solutions, of course, the desired pH is actually reproduced in a solution and the colour of the indicator produced by it is used as a standard. In the methods of Gillespie and Medalia, such standard colours are produced in a simple manner, that is, by reproducing the colour indicative of the desired pH values by blending, in different amounts, the two extremes of the colour change. A description of the technique of the preparation of the colour standards will serve to make the point clearly understood.

Test-tubes of similar diameter and thickness are essential. Two rows of seven test-tubes are placed in a test-tube rack: into the tubes in the first row 10 cc. of a solution of sodium hydrate in distilled water is pipetted. The tubes in the second row contain 10 cc. of dilute hydrochloric acid. Increasing amounts of the indicator are now added to the alkaline tubes beginning at the tube on the left (No. 1) with 0.1 cc. and proceeding by increments of 0.1 cc. to 0.7 cc. through the series of seven tubes. Similarly the indicator is added to the acid tubes, but the tube on the right (No. 7) is commenced with in this case. It will be seen that collectively every two corresponding tubes contain 0.8 cc. of the

indicator, and that each pair of tubes of the series differs from the others by its relative proportion of the amounts of acid and alkaline indicator.

Tube No. 1 of the first row contains 0.1 cc. indicator in alkaline medium and Tube No. 1 of the second row contains 0.7 cc. indicator in acid medium, whilst at the other end of the series No. 7 of the first row contains 0.7 cc. indicator in alkaline medium, and No. 7 of the second row contains 0.1 cc. of the indicator in acid medium. Between Nos. 1 and 7, observing each two corresponding tubes together by transmitted light, there are the necessary variations in depths of colour produced by acidity and alkalinity to reproduce the stages in the colour change.

Since the colour standards are not prepared to represent extreme alkalinity or acidity at either end, the initial and final pH values will of course be omitted at the beginning and end of the series respectively, and each pair of tubes will be equivalent to increments of pH 0.2.

We take the liberty of reprinting the tables published by Medalia showing the strengths of acid and alkaline reagents employed, and the pH values obtained by using the Clark and Lubs' indicators in the manner he describes.

**Composition of "Standard Colours" prepared with thymol-blue—acid range,
0.02 per cent. watery solution—range pH 1.4 to pH 2.6.**

Pair	Tube	0.001 Per cent. HCl	Indica- tor	Tube	0.5 Per cent. HCl	Indica- tor	COLOUR	pH
		cc.	cc.		cc.	cc.		
1	1	10	0.1	2	10	0.7	Red	1.4
2	1	10	0.2	2	10	0.6	Lighter red	1.6
3	1	10	0.3	2	10	0.5	Yellow red	1.8
4	1	10	0.4	2	10	0.4	Red yellow	2.0
5	1	10	0.5	2	10	0.3	Beginning yellow	2.2
6	1	10	0.6	2	10	0.2	More yellow	2.4
7	1	10	0.7	2	10	0.1	Still more yellow	2.6

Composition of "Standard Colours" prepared with brom-phenol-blue 0.02 per cent. watery solution—range pH 3.4 to 4.6.

Pair	Tube	$\frac{N}{200}$ NaOH	Indicator	Tube	0.1 Per cent. HCl	Indicator	COLOUR	pH
		cc.	cc.		cc.	cc.		
1	1	10	0.1	2	10	0.7	Yellow	3.4
2	1	10	0.2	2	10	0.6	Light yellow	3.6
3	1	10	0.3	2	10	0.5	Beginning pink	3.8
4	1	10	0.4	2	10	0.4	Pink-red	4.0
5	1	10	0.5	2	10	0.3	More red	4.2
6	1	10	0.6	2	10	0.2	Beginning blue	4.4
7	1	10	0.7	2	10	0.1	Blue	4.6

The blue colour of this indicator can be brought out with $\frac{N}{20}$ NaOH, but is not lasting and fades within twenty-four to forty-eight hours, while the $\frac{N}{200}$ NaOH makes a lasting range of "colour standards."

Composition of "Standard Colours" prepared with brom-thymol-blue 0.02 per cent. watery solution—range pH 6.4 to 7.6.

Pair	Tube	$\frac{N}{20}$ NaOH	Indicator	Tube	0.1 Per cent. HCl	Indicator	COLOUR	pH
		cc.	cc.		cc.	cc.		
1	1	10	0.1	2	10	0.7	Yellow	6.4
2	1	10	0.2	2	10	0.6	Lighter yellow	6.6
3	1	10	0.3	2	10	0.5	Yellow green	6.8
4	1	10	0.4	2	10	0.4	Green	7.0
5	1	10	0.5	2	10	0.3	Bluish green	7.2
6	1	10	0.6	2	10	0.2	Greenish blue	7.4
7	1	10	0.7	2	10	0.1	Blue	7.6

The useful range of colour of this indicator, according to calibration with phosphate NaOH mixture, should begin with pH 6.2, instead of pH 6, as given by Clark and Lubs.

Composition of "Standard Colours" prepared with methyl red 0.02 per cent.
watery solution—range pH 4.6 to pH 5.8.

Pair	Tube	N — NaOH 20	Indica- tor	Tube	0.1 Per cent. HCl	Indica- tor	COLOUR	pH
		cc.	cc.		cc.	cc.		
1	1	10	0.1	2	10	0.7	Red	4.6*
2	1	10	0.2	2	10	0.6	Light red	4.8
3	1	10	0.3	2	10	0.5	Yellow red	5.0
4	1	10	0.4	2	10	0.4	Red yellow	5.2
5	1	10	0.5	2	10	0.3	Beginning yellow	5.4
6	1	10	0.6	2	10	0.2	More yellow	5.6
7	1	10	0.7	2	10	0.1	Yellow	5.8

* There was a very slight difference between the phthalate NaOH mixture and the "Standard Colours" in the first three pairs: Pair No. 1 = pH 4.7; Pair No. 2 = pH 4.9; Pair No. 3 = pH 5.1 according to the phthalate NaOH mixture, the rest were the same in both.

Composition of "Standard Colours" prepared with brom-cresol-purple 0.02
per cent. watery solution—range pH 5.4 to pH 6.6.

Pair	Tube	N — NaOH 20	Indica- tor	Tube	0.1 Per cent. HCl	Indica- tor	COLOUR	pH
		cc.	cc.		cc.	cc.		
1	1	10	0.1	2	10	0.7	Yellow	5.4
2	1	10	0.2	2	10	0.6	Lighter yellow	5.6
3	1	10	0.3	2	10	0.5	Beginning pink	5.8*
4	1	10	0.4	2	10	0.4	Pink	6.0
5	1	10	0.5	2	10	0.3	Beginning purple	6.2
6	1	10	0.6	2	10	0.2	More purple	6.4
7	1	10	0.7	2	10	0.1	Purple	6.6

* According to phthalate and phosphate NaOH mixtures, pairs 3, 4, 5, 6, 7, should read: pH 5.9; 6.1; 6.3; 6.5; 6.7.

Composition of "Standard Colours" prepared with cresol-red 0.02 per cent. watery solution—range pH 7.4 to pH 8.6.

Pair	Tube	N — NaOH 20	Indica- tor	Tube	0.1 Per cent. HCl	Indica- tor	COLOUR	pH
		cc.	cc.		cc.	cc.		
1	1	10	0.1	2	10	0.7	Yellow	7.4
2	1	10	0.2	2	10	0.6	Lighter yellow	7.6
3	1	10	0.3	2	10	0.5	Pink yellow	7.8
4	1	10	0.4	2	10	0.4	Yellow pink	8.0
5	1	10	0.5	2	10	0.3	Pink	8.2
6	1	10	0.6	2	10	0.2	Beginning red	8.4
7	1	10	0.7	2	10	0.1	Red	8.6

Composition of "Standard Colours" prepared with thymol-blue-alkaline—range 0.02 per cent. watery solution—range pH 8.2 to 9.4.

Pair	Tube	N — NaOH 20	Indica- tor	Tube	0.001 Per cent. HCl	Indica- tor	COLOUR	pH
		cc.	cc.		cc.	cc.		
1	1	10	0.1	2	10	0.7	Yellow	8.2
2	1	10	0.2	2	10	0.6	Light yellow	8.4
3	1	10	0.3	2	10	0.5	Yellow green	8.6
4	1	10	0.4	2	10	0.4	Green	8.8
5	1	10	0.5	2	10	0.3	Green blue	9.0
6	1	10	0.6	2	10	0.2	Faint blue	9.2
7	1	10	0.7	2	10	0.1	Blue	9.4

Composition of "Standard Colours" prepared with phenol red 0.04 per cent. watery solution—range pH 7 to pH 8.2.

Pair	Tube	N — NaOH 20	Indica- tor	Tube	0.1 Per cent. HCl	Indica- tor	COLOUR	pH
		cc.	cc.		cc.	cc.		
1	1	10	0.1	2	10	0.7	Yellow	7.0
2	1	10	0.2	2	10	0.6	Lighter yellow	7.2
3	1	10	0.3	2	10	0.5	Pink yellow	7.4
4	1	10	0.4	2	10	0.4	More pink yellow	7.6
5	1	10	0.5	2	10	0.3	Beginning red	7.8
6	1	10	0.6	2	10	0.2	Slightly more red	8.0
7	1	10	0.7	2	10	0.1	Red	8.2

The "Comparator" has been improved by having passed through the hands of many workers, and can be easily made in the laboratory. It consists of a block of wood with holes bored in it from the top so that it will hold three sets of three test-tubes. Three holes are also bored from the front so that each set of tubes may be viewed by transmitted light whilst super-imposed. Fig. 1 will illustrate this. It has been found convenient to encase the comparator block in a cardboard tube bent at an angle, so that, by inserting a mirror inside the bend, the tubes may be viewed from above.

By encasing the block only the light from the luminant is used (Fig. 3); in our case this is an ordinary incandescent gas burner with a ground glass plate interposed. A ground glass plate is also placed against the front of the block.

For observations upon wort, beers, or wines the indicator, Thymol Blue (acid range), Brom-phenol-blue, Methyl Red, Brom-thymol-blue are sufficient for ordinary needs, and Brom-phenol-blue is usually within the range of the pH of wort or beer. Solutions to be investigated should be filtered until optically clear: this is easily accomplished in the case of those liquids which we have now under consideration.

Having ascertained which indicator is to be employed, the comparison of 10 cc. of the fluid containing 0.8 cc. indicator (the amount contained in each pair of colour standard tubes) is made. It is necessary to compensate for the colour of the fluid itself, so that tubes of the fluid without indicator are used in addition to the standard tubes; and two tubes of distilled water are super-imposed on the fluid and indicator tube to compensate for the standards.

According to Fig. 2, tubes in the holes A and G will contain the fluid under examination without addition of any kind. D will contain the fluid + 0.8 cc. indicator. E and F contain distilled water. In B and C a pair of the standard tubes which approximately matches the colour of D is placed. The next pair of tubes in the series occupies H and I, and the pairs of tubes are adjusted by replacement until D is matched, or until its colour rests between the standards on either side. In this latter case the pH reading

will, of course, be intermediate to those expressed by the two standards. It will be seen that a true comparison is made by having the optical effect of the fluid, glass, water, and the quantity of indicator constant in each three tubes.

The indicator solutions are prepared by diluting a 0.2% alcoholic stock solution with distilled water in the proportion of 1 : 10. It is necessary to take precautions with both the indicators and standard colour preparations by protecting them from light, evaporation, and infection by moulds. We have found it necessary to frequently prepare fresh colour standards for use when brom-phenol-blue is employed, since the stability of the alkaline colour in $\frac{N}{200}$ NaOH is somewhat variable.

The phenomenon of dichromatism is particularly manifest in solutions containing brom-phenol-blue; a yellow screen placed between the comparator and the luminant largely compensates for this, but the operator will find that familiarity with the instrument enables him to differentiate between the true colours and those produced by this optical effect.

We reproduce tables showing the pH value of three samples of beer after retention for three or four weeks at the temperatures indicated, and also the pH values of several bottled beers as purchased. It will be seen from this that a relationship is apparent between acid taste and concentration of the hydrogen ion. Two opinions were obtained upon the taste in all cases; and one observer performed the titrations throughout in order that the personal factor might be regarded as constant.

Since acid taste is a question of H.I.C. it would appear that a more definite expression of acidity could be obtained by a reading of the pH value. Acidity expressed as a percentage of acetic acid by titration with $\frac{N}{2}$ sodium hyd'ate is somewhat misleading as an indication of acid taste. 20 cc. $\frac{N}{2}$ NaOH solution is equivalent to 20 cc. $\frac{N}{2}$ acetic acid, and also 20 cc. $\frac{N}{2}$ HCl, but the latter would be responsible for a much more "acid" taste, owing to its greater dissociation and consequent greater number of free hydrogen ions.

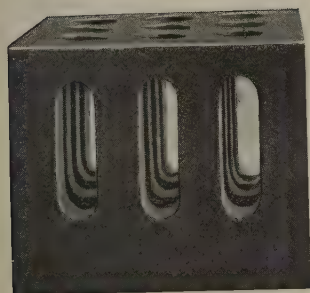


FIG. 1.

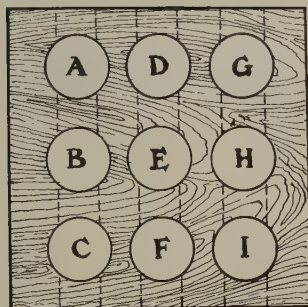


FIG. 2.

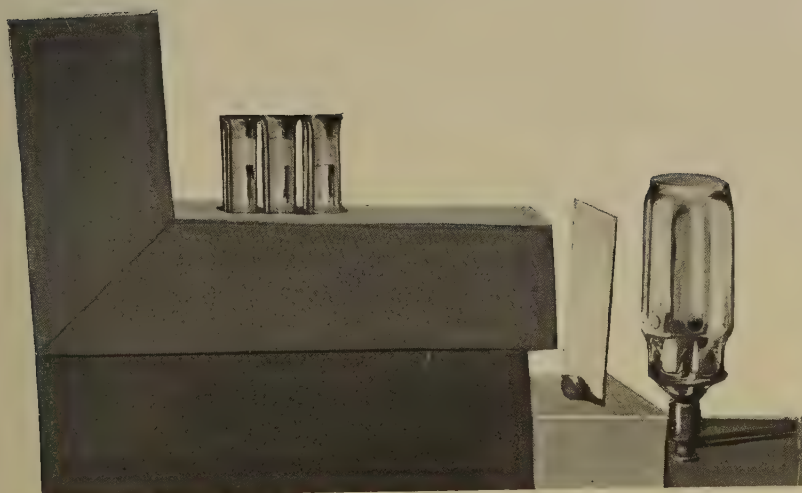


FIG. 3.

A much more thorough investigation is necessary before a real value may be placed upon the joint consideration of the figure obtained by titration with alkali and the pH value. The pH, of course, will not correspond with the NaOH figure of different fluids unless those fluids have an identical constitution ; a difference in the nature of the acids and the amounts of " buffers " present, whilst not manifest in titration, would be shown by a difference in the pH value. An acid having a lower dissociation than acetic acid, that is, a weaker acid with a consequently less acid taste, may be present in amounts which, when expressed as acetic acid by the NaOH figure, would lead one to expect a more acid taste than actually occurs.

It is found that at a pH of 3.9 the acidity to the taste is so slight as to be occasionally masked by flavours of a different character.

Sample	Per cent. Acidity.	pH	Taste
I.	0.117	4.1	Not acid
II.	0.093	4.0	Not acid
III.	0.123	3.8	Slight acidity
IV.	0.096	3.9	{ Not acid (F.A.M.) (?) Suspicion of acidity (P.H.)
V.	0.075	3.9	
VI.	0.066	3.9	
VII.	0.096	3.9	Suspicion of acidity

SAMPLE	ON RECEIPT			AFTER 21 DAYS			AFTER 28 DAYS		
	Per cent. Acidity*	pH	Taste	Per cent. Acidity	pH	Taste.	Per cent. Acidity	pH	Taste
I.	27°C	—	—	0.153	3.9	Excellent	0.165	3.9	Very good
	15°C	0.075	4.1 Normal	0.130	4.1	Excellent	0.125	4.1	Very good
II.	27°C	—	—	0.177	3.5	Acid	0.225	3.5	Acid
	15°C	0.075	3.9 Normal	0.114	3.9	Normal	0.114	3.9	Normal
III.	27°C	—	—	0.162	3.6	Rather acid	0.213	3.5	Acid
	15°C	0.063	4.1 Normal	0.156	3.8	Faint acidity	0.154	3.7	Slight acidity

* The acidity is expressed as percentage acetic acid by titration with NaOH.

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Micro-Organisms

in the

Leather Industries

1. A SYSTEMATIC ARRANGEMENT OF THE FUNGI MENTIONED IN THE LITERATURE OF LEATHER TECHNOLOGY.

ALTHOUGH certain micro-fungi occur so commonly in the tannery that their presence is a matter of every-day observation, the text-books of the leather industry supply very little useful information concerning them. This fact is due, no doubt, to the uncertainty which exists with regard to the names of the species that occur on leather and leather-making materials, as well as to the lack of definite knowledge of the relationships of the fungi to the substances on which they are found. We are unable to find any systematic account of these fungi, and the leather mycologist is seriously hampered in any attempt to correlate his work with the results of previous investigations, or to determine whether an organism with which he is working, has been previously observed in connection with the tanning industry.

Before any real progress can be made in the study of an organism on any substance or in any technical process, the

identification of that organism is essential. It is surprisingly easy in any work involving the use of micro-organisms, to commence with one species and to end with another of quite a different character; and it is necessary to have a sufficient acquaintance with the microscopical differences of organisms like moulds and yeasts in order to check the purity of any one of them during the stages of an investigation. To a tanner familiar with the gelatinous nature of the fibres composing the *corium*, this necessity will become apparent when it is pointed out that, of two moulds of similar habit of growth, colour and size, one will liquefy gelatine while the other will not. Among yeast-like organisms, a number of unicellular *Mycodermæ* are quite inert in their behaviour towards leather, whereas, one or two species, microscopically indistinguishable from the former, produce unsightly stains on finished leather and thus function as serious destructive agents.

In the course of our work on the micro-biology of leather, skins and tanning materials, several species of fungi not previously recorded on these substances have been isolated and cultivated. On the other hand, many of the species one is led to expect from a study of the literature have been rarely observed. Among some thirty species of fungi mentioned in text-books, several of them rest upon identifications by early workers, and on account of the state of mycological knowledge at the time those species were first observed, very little reliance can be placed upon their names. It would appear, therefore, that before any good purpose is likely to be served by the addition of new names to a list of fungi that can convey little intelligence to the technologist, it is necessary to examine the list as it exists at present and to classify the organisms it represents.

The term "mould" has been used in the preceding paragraphs, and it is an expression in every-day use, but it is important to realise that it possesses no scientific meaning. The mycologist

recognises many hundreds of species of fungi, any one of which, the ordinary observer would call a "mould." It is obvious, therefore, that as it is restricted to no single species the term "mould" is only permissible in a popular sense and with a collective meaning; indeed, its application is so elastic that it embraces micro-fungi belonging to very widely-different natural groups. Even in the ordinary way a more careful observer distinguishes three types of mould, viz. : blue moulds, grey moulds and black moulds. The blue moulds are usually regarded as *Penicillium glaucum*, the grey moulds as *Mucor mucedo*, and the black ones as *Aspergillus niger*. The black mould might occasionally be *A. niger*, but it is very unlikely that the other names would be correct. *Penicillium glaucum* is now known to have had a meaning little less restricted than that of the word "mould" itself, and it is not at present recognised as a distinctive species. It is probable that each leather technologist who has recorded this fungus has had under observation a different species.

It will thus be evident to the student that there are unsuspected pitfalls to be encountered in the pursuit of mycological knowledge, and the following notes on the systematic aspects of the subject may enable him to avoid some of them.

Mycology embraces the study of all those plants known to botanical science as *fungi*; it includes a knowledge of their forms, structure, physiology, life-history and relationships, and their classification. Technical mycology is the application of this knowledge to the species of importance in economic science and industry, whether the fungi function as useful or detrimental organisms. In the present paper we are concerned only with the systematics of the fungi so far recorded in connection with leather manufacture, and as a preliminary step in a consideration of these, the following table will serve to elucidate the position occupied by the fungi among other plants.



It will be seen from this table that the special character which separates the fungi from all other plants is the absence of chlorophyll. This is probably the only difference that can be safely assumed, although, of course, structure and physiological activities are both correlated with this fact. In the absence of chlorophyll, photosynthesis, the process by means of which the higher plants assimilate simple carbon compounds, cannot operate and the fungi must take up their carbonaceous food in the form of relatively complex substances.

Some fungi derive their nourishment from living plants or animals; some from dead organisms or the products of living organisms. In the former case the fungus lives as a *parasite*, e.g., *Trichophyton megalosporon*, the "ringworm" disease of cattle, and *Uromyces glumarum*, the fungus known as "rust" on cereals. Fungi living on dead or decaying organic substances are known as *saprophytes*, e.g., *Aspergillus niger* on leather, *Cladosporium commune* on canvas and *Mycoderma tannica* on the surface of tan-liquors. In other cases two fungi may live in a state of intimate relationship for the welfare of each other, as instanced by the "ginger-beer plant" or "Californian bees," which consists of a bacterium and a yeast, *Bacterium vermiciforme* and *Saccharomyces pyriiformis* respectively. Or, a fungus may form a partnership with (or live parasitically on) an alga, the result of which is an organism of a dual nature, known as the "lichen." Again, the fungus may grow in association with the higher flowering plants such as the Heaths and the Orchids, with advantage to the latter plants. In each of these cases the relationship is known as that of *symbiosis*.

On further reference to the table it will be seen that the fungi are sub-divided as follows:—

(I.) *Myxomycetes*.—This term has been used for the sake of preserving uniformity in the terminology of the three main groups. It is derived from Greek roots meaning "slime-fungi" on account

of the peculiar slimy condition assumed by these plants in an early stage of their development. In modern mycological literature the term *Mycetozoa* is used and is to be preferred, as these organisms, in the course of the various stages of their life-history, exhibit the characteristics of both plants and animals. They are included in the fungi here, although it must be pointed out that their exact position in the scale of living organisms is still a matter of controversy, and they come so near to the borderline separating plants from animals—if such a line exists—that their study is included in both zoological and botanical text-books. None of the species are of any importance to the leather mycologist, and details of their structure and character need not be discussed. One species, *Fuligo septica* Gmelin, known as “flowers of tan,” may be mentioned, as it is frequently found growing on spent tan, and it is one in which the slimy *plasmodium* stage is well marked and easily observed.

(II.) *Schizomycetes*.—These are the unicellular fungi, typically reproducing by fission or simple lateral division, known as *bacteria*. The mycology of the leather industries was founded by the researches of J. T. Wood on these organisms in connection with the bating and drenching of skins, and their study now occupies an important place in leather technology. Although a great deal of careful work has been done with regard to the biology, physiology and relationships to industry, of certain species belonging to this group, there is a considerable number mentioned in the literature about which very little is known: it is proposed to discuss and classify these in a later paper. At this stage it is only necessary to refer to them in connection with their botanical position.

(III.) *Eumycetes*.—These are the true fungi vegetating by means of mycelia, and reproducing by the formation of spores produced either asexually, or as a result of sexual processes. In our table these are again sub-divided into *Phycomycetes* and *Mycomycetes*, a sub-division based on the absence or presence of transverse septa in the vegetative hyphae, but this separation

must only be regarded as fundamental and not absolute, as this character frequently does not hold good. The *Phycomycetes* would, perhaps, more accurately be described as alga-like fungi. Together these two groups are still further sub-divided into five sub-groups, those of immediate interest to us being printed in larger type.

It is not our intention to discuss the relationship of the fungi composing these groups, and it is now proposed to collect the names of species from the sources indicated and to classify them under the three orders—Zygomycetes, Ascomycetes and Fungi Imperfecti.

The following statements and lists of species contain all the Eumycetes known in connection with leather technology, and they are abstracted from—

- (1) "The Puering, Bating and Drenching of Skins," by Joseph Turney Wood, 1912.
- (2) "The Sheep and its Skin," by Alfred Seymour Jones, 1913. This work contains an appendix on "The Bacteriology of the Leather Industry," by J. T. Wood, which includes a list of the organisms investigated by Prof. F. Andreasch, of Vienna.
- (3) "Physiologische Untersuchungen über eine neue, in der Gerbbrühe gedeihende Kahlmhefe," by T. Asai, *Journ. of the College of Science*, Imperial University of Tokyo, Vol. XXXIX., Art. 7, May 30th, 1918.

Where an organism has been already mentioned by one authority it is not repeated in abstracting from another source. Wood, *op. cit.*, p. 115, says:—

- (a) "The following species have been noted and classified as growing on dog-dung, though probably not all of them are specific:—

Pilaira dimidiata (Grove).

Mucor caninus (a variety of *Mucor mucedo*).

Circinella simplex (Van Tieghem).

Pilobolus crystallinus (also on cow-dung)."

- (b) "Certain myxobacteria are found on dung, among these *Chondromyces*, described as long ago as 1857 by Berkeley, and at that time included among the *Hyphomycetes*. It was rediscovered in 1892 by Thaxton, and owing to his researches the whole class of myxomycetes is now generally considered as a division of Bacteria. Another myxomycete, *Polyangium primigenum* Quehl, forming a red fructification on dog-dung, is figured in the "Encyclopædia Britannica," XI. Edition, Vol. 3, p. 163."

Further, p. 126, Wood says:—

"Moulds taking part in putrefaction, principally of fruit and vegetable matter:—

Penicillium glaucum.

Mucor mucedo.

Mucor piriformis Fischer, possibly identical with 2.

Mucor stolonifer Ehrenberg.

Botrytis cinerea Pers.

Mucor racemosus Fres.

Monilia fructigena Pers.

Fusarium putrefaciens Osterwalder.

Cephalothecium roseum."

A. Seymour Jones, *op. cit.*, p. 379 (Andreasch), gives the following yeasts and yeast-like organisms:—

"*Saccharomyces pastorianus* Hansen.

S. ellipsoideus Hansen.

S. apiculatus Reess.

S. ellipsoideus 1 Hansen.

S. acidi lactici Grotenfeld.

A rose-coloured torula.

An orange-yellow torula.

Mycoderma."

Asai, *loc. cit.*, pp. 37 and 38, adds the following species, most of which have not been found to bear specific relationship to leather or tanning materials, but have been obtained from the atmosphere of a tannery by means of Petri dish exposures :—

- “ *Rhizopus nigricans* Ehrenberg.
- Aspergillus glaucus* Link.
- Aspergillus niger* Van Tieghem.
- Penicillium* sp.
- Pestalozzia* sp.
- Verticillium glaucum* Bon.
- Cladosporium herbarum* (Pers.) Link.
- Macrosporium cladosporioides* Desm.
- Alternaria tenuis* Nees.
- Fusarium roseum* Link.
- Mycoderma tannica* Asai.”

Before classifying these species, one or two critical observations may be made. *Mucor caninus*, mentioned by Wood as a variety of *Mucor mucedo*, has had a varied history. *Mucor caninus* was first described as a separate species by Persoon ; it was afterwards reduced to the rank of variety by Massee, who called it *Mucor mucedo* var. *caninus*, but even this separation has not withstood later opinion, and it is now considered to be the species *Mucor Mucedo* (Linn.) Bref.

In paragraph (b) Wood has unfortunately confused two of the three main groups of the fungi by the use of the term “myxomycete” for myxobacterium. The Myxomycetes, as already explained, are the slime-fungi, while the Myxobacteria belong to the Schizomycetes, and a good deal of misconception is likely to arise from the statement that “the whole class of myxomycetes is now generally considered as a division of bacteria.”

"Thaxton," mentioned in the same paragraph, should read "Thaxter," the latter being the name of the American mycologist whose work on the *Myxobacteriaceae* is well known.

Penicillium glaucum, as stated in an earlier paragraph, is not recognised as a species by Thom, Westling or other investigators of the genus, and the organism so named cannot be recognised.

Mucor stolonifer, referred to by Wood, and *Rhizopus nigricans*, mentioned by Asai, are synonyms of *Rhizopus stolonifer* (Ehrenb.) Lind.

Saccharomyces apiculatus Reess, as given by Andreasch, is now known to produce only one spore, and in accordance with modern classification it must therefore be placed in the genus *Hansenia* (Lindner) Klöcker.

The rose-coloured torula, the orange-yellow torula, and the Mycoderma, also quoted from Andreasch, cannot now be recognised, and they will not be included in the following list. Although torulae and mycodermae are frequently mentioned in text-books, the only satisfactory work on these organisms is that of T. Asai, who has described *Mycoderma tannica*. These yeast-like fungi are usually considered along with the yeasts in their relationship to industry, as well as on account of their morphological similarity, but in a systematic arrangement of the species they cannot be included in the Ascomycetes, as they do not form spores. The systematic position of the Mycodermae appears to have received little attention, and until some definite place can be found for them we have placed them at the end of the fungi imperfecti. It must not be assumed from this that they follow naturally the Tuberculariaceae, but that they cannot, for the present, be assigned a more definite position.

ZYGOMYCETES.

MUCORINEAE.

MUCORACEAE.

MUCOR Micheli emend. Link.

racemosus Fres.

Mucedo (Linn.) Bref.

piriformis Fischer.

CIRCINELLA van Tiegh. et Le Monn.

simplex van Tiegh.

RHIZOPUS Ehrenberg.

stolonifer (Ehrenb.) Lind.

PILOBOLACEAE.

PILAIRA van Tiegh.

dimidiata Grove.

PILOBOLUS Tode.

crystallinus (Wiggers) Tode.

ASCOMYCETES.

GYMNOASCALES.

GYMNASCACEAE.

SACCHAROMYCETES

SACCHAROMYCES Meyen.

ellipsoideus Hansen.

Pastorianus Hansen.

acidi lactici Grotenfelt.

HANSENIA (Lind.) Klöcker.

apiculata Lindner.

FUNGI IMPERFECTI.

MONILIALES (Hyphomyceteae).

MONILIACEAE.

HYALOSPORAE.

MONILIA (Pers.) emend. Sacc.

fructigina Pers.

ASPERGILLUS Micheli.

glaucus Link.

niger van Tiegh.

PENICILLIUM Link.

(No recognisable species.)

BOTRYTIS Micheli emend. Sacc.

cinerea Pers.

VERTICILLIUM Nees.

glaucum Bon.

CEPHALOTHECIUM Corda.

roseum Bon.

DEMATIACEAE.

DIDYMOSPORAE.

CLADOSPORIUM Link.

herbarum Pers.

DYCTOSPORAE.

MACROSPORIUM Fries.

cladosporioides Desm.

ALTERNARIA Nees.

tenuis Nees.

TUBERCULARIACEAE.

MUCEDINIA.

PHRAGMOSPORAE.

FUSARIUM Link.

roseum Link.

putrefasciens Osterwalder.

Yeast-like fungi: film-forming, non-sporulating organisms, developing only by budding:—

MYCODERMA Persoon.

tannica Asai.

Notes and Comments

A portion of a paper entitled "Pests and Diseases of Barley and Malt," Part 1—"Injurious Insects," was read by F. A. Mason, at a Meeting of the London Section of the Institute of Brewing, held in the rooms of the Institute of Chemistry, on March 21st. This was illustrated by lantern slides, and mounted specimens of the insects mentioned in the paper, which included an exhibit showing the life-history of *Trogoderma khapra*, the insect pest referred to in *Bulletin* No. 2.

We have now proved the presence of *T. khapra* in maltings and breweries in Warwickshire, Nottinghamshire, Staffordshire, Somersetshire, Yorkshire, and the London district. The insect turns up in many places quite unexpectedly. A client in Somersetshire writes as follows:—

"Referring to my interview at your Stand during the Brewers' Exhibition in regard to Weevil and other grain pests, I now enclose specimens of two kinds found here: the ones in the glass tube were found in some screenings of Foreign barley; the small specimens, which I imagine are the ordinary weevil, were found on some sacks of English barley and were also swarming in a bin of English malt which had been stored for nearly twelve months. I shall be glad to know what you think of them."

Examination of the above samples showed that the "weevils" were the larvæ of *Trogoderma khapra*. This confirms our contention that the trade sack is a serious source of infection. These sacks in course of time get distributed all over the country, and infection is bound to follow. The insects obtained from the screenings of foreign barley were the larvæ of Meal Beetles. These are still in the larval stage and it is hoped to identify them after the beetles have been bred out. They appear to be omnivorous feeders, and

show even a greater preference for the cork of the bottle in which they are stored than they do for the grain in which they were found.

The agenda for the last Meeting of the Leather Industries Section of the Royal Microscopical Society included a paper—"An Investigation of the Cause of 'Run' Pelts," read by Mr. P. Hampshire.

Messrs. F. A. Mason and P. Hampshire are both associated with the work of the above-mentioned Section of the R.M.S.

Mr. T. Parker, F.R.H.S., a member of our London technical staff, has been appointed a member of the Advisory Committee of the London Chamber of Horticulture.

A TROUBLESOME ANT.

The grill-room and other rooms of a large London Hotel were badly infected with a pest which proved to be a small ant, *Monomorium pharaonis*. The insects showed a partiality for sweetmeats, all of which were attacked if left exposed for a short time. A large wedding cake was seized upon by a whole army of ants, and was so badly damaged that it became unfit for human consumption. These ants, although not of frequent occurrence, are found in houses and restaurants in several of the larger towns of this country, where they feed on provisions of various kinds.

MITES AS BREWERY PESTS.

Another client in the West of England sends us the following interesting communication:—

"I have been interested in the article in *Bulletin* No. 2 on *Trogoderma khapra*, and I am sending you to-day a tin filled with bran which you will find alive with mites of one

sort or another. Some few weeks ago a few bags of bran were brought in for our horses, and after these bags had been standing for a few days the floor all around them was covered with millions of these little fellows which had got through the texture of the sacking. I find another species inhabiting breweries usually in the neighbourhood of fermenting vessels, especially if they are damp ones. Some years ago I had two vessels covered or really *plastered* with them below the floor line and had a fearful difficulty in getting rid of them."

The above sample contained enormous numbers of the mite, *Aleurobius farinæ*, a creature often very troublesome in flour, bran and other cereal products. Subsequent specimens of the other mite, mentioned as frequenting the fermenting vessels, were found to be another species, *Glyciphigus cadaverum*. A very good distinctive feature of the latter mite is the long hairs which surround the body of the creature, and these have the effect of making it appear much bigger than it really is. This mite occurs commonly in many cereal products, and may be found in almost any brewery or other place where grain is used.

FARM AND GARDEN PESTS.

Cabbages received from the South of England were found to be galled by *Ceutorhyncus sulcicollis* Gyll. "Red Spiders" collected in the vicinity of bean plants proved not to be the pest of greenhouses, etc., known as Tetranychus, but the velvet mite, *Trombidium holosericeum*. Full-grown grubs of the cockchafer, *Melolontha vulgaris*, have been received from Hampshire, where they have been very destructive. Springtails (*Collembolæ*) appear to be particularly numerous this year, and specimens have been received from several parts of the country. Beetles from apple trees in the London district were found to be *Phyllobius oblongus*, an insect not confined particularly to apple trees, but liable to be found on various trees, shrubs and plants.

Specimens of cabbage seedlings only a few inches high have been examined which had already become badly infected with Club-root or Finger-and-Toe disease, *Plasmodiophora brassicæ*. Conifer seedlings badly damaged and rendered unsightly by the attacks of *Pineas pini* Linn., and plum trees suffering badly from the presence of *Aphis pruni* have all been reported from the London district. In a garden in Gloucester large numbers of weevil larvæ were observed and reported to be doing much damage to flowering plants and vegetables ; finally the perfect insect was sent to us and found to be *Otiorhyncus sulcatus*. The White fly or Snow fly, *Aleyrodes brassicæ*, has been reported on tomatoes, cabbage, and greenhouse plants. This small moth-like insect usually occurs in enormous numbers, and F. T. Theobald records a case in which one of his correspondents wrote saying "They come out in clouds like very fine snow and the wind blows them all over the garden—every plant of cabbage, cauliflower, sprouts, broccoli, etc., are attacked and three-fourths of my vegetables are lost."

SOME PRESS COMMENTS

Nature, April 28th, 1921, says :—

" We have received *Bulletin* No. 2 of the Bureau of Bio-Technology (January, 1921), a newly-established quarterly publication issued from the biological department of Messrs. Murphy & Son, of Leeds. Although it runs to only 25 pages it contains two articles of considerable interest. One concerns the destruction of stored malt by the agency of a Dermestid beetle, *Trogoderma khapra* Arrow. This species has been recorded as an occasional rarity, but there appears to be no previous instance of its occurring in sufficient numbers to cause appreciable damage. There seems to be no doubt that the presence of this beetle is due to infected shipments of barley from Karachi and other Indian ports. The second article refers to Nematode worms in relation to leather manufacture, these organisms being found in large numbers during the process of removing wool from skins by means of 'sweating.' It is undoubtedly a healthy sign that a business house deems it worth while to issue a periodical of this nature. Apart from any function by way of advertisement, it should serve as an outlet for the publication of research work carried out in the firm's own laboratories. It is well printed and the illustrations adequately fulfil the purpose intended."

Although the following references to *Bulletin* No. 1 appear rather belated, they had not been published before our last issue went to press.

The Brewers' Journal, December 15th, 1920, comments as follows :—

" A New House Magazine.—This is the day of the revival of House Organs or Magazines. The tendency is for modern British examples to show the influence of trans-Atlantic models, which is another way of saying that both in matter and get-up they make a bolder bid for attention than some of their more modest predecessors. We have before us *Bulletin* No. 1 (even the title has a trans-Atlantic sound) of the Bureau of Bio-Technology, Queen Square, Leeds, which readers will recognise as one of the addresses of Messrs. Murphy & Son, Ltd. Some might describe it as almost extravagantly got up; it is certainly an attractive example of the printer's art. The cover will arrest attention and, having perused the contents, we think these will continue to hold it. It is true the longest article is a reprint from the *Chemical Age*, but few brewers read the *Chemical Age*, and the article originated in the Bureau, coming from the pen of its Director, Mr. F. A. Mason. To one of Mr. Mason's statements we must demur. He says neither biology nor microscopy 'has been considered to lie within the legitimate scope of the chemist's profession.' It is not every chemist who finds it necessary or worth while to devote much time to the study of biology or microscopy, but a large and increasing number do. Microscopy has figured in the examinations of the Institute of Chemistry for more years than we can remember, whilst a special examination in Biological Chemistry was instituted many years ago. The *Bulletin* further includes a readable article on System (or lack of system) in the Nomenclature of Bacteria."

We welcome the reviewer's demurrance to one of our statements as much as we appreciate his other remarks. "Generally accepted" would have expressed the position more accurately than "legitimate."

The Leather Trades' Review, January 12th, 1921, page 16, comments as follows :—

"BIO-TECHNOLOGY AND LEATHER MANUFACTURE.

As an example of the ramifications of science and the utilisation of many of its branches simultaneously, the leather industry commends itself for especial notice. The chemist, organic and inorganic, the physicist and the engineer have each their accredited position in the tannery, but the biologist and the physiologist, on whose preserves of preliminary treatment and actual tanning of the skins take place, appear more as onlookers than participants.

The comparatively recent works of Mr. J. T. Wood, Mr. Alfred Seymour-Jones and Dr. G. Abt have, to say the least, stated an irrefutable claim for the importance of the biological and physiological points of view, and have promised considerable stimulus for further endeavour in that direction.

The dictum of the late Lord Allerton that 'good leather is made in the beam house' has been quoted many times. Is it not at this stage when the physiological character of the skin is most easily influenced by forces other than those purely chemical or physical? One may quote the control of many defects, occurring before the pelt enters the tan-house, due to partial putrefaction or imperfect unhairing, drenching or bating.

The acid producing and diastatic properties of moulds and micro-organisms in the tan liquors are points worthy of attention, and in the examination of vegetable tanning materials the microscopist and botanist are not to be ignored. It is such considerations which have prompted the Bureau of Bio-Technology, Leeds, to extend their resources to meet a specialised need of the tanning industry for which the routine chemical laboratory is seldom equipped. By means of the facilities afforded by their bacteriological and biological laboratories, it should be that the bureau will be of considerable utility to the tanning and allied industries in the investigation of problems which come within their scope."

The Fruit, Flower and Vegetable Trades' Journal, January 15th, 1921, with reference to *Bulletin* No. 2, says :—

"The issue of such a technical treatise is a true sign of the times, illustrating the widespread interest in the biological aspect of industry. Messrs. Murphy & Son are to be complimented on their good services in that direction."

The Brewing Trade Review, Dec. 1st, 1920 :—

"A modern development of research work is that being undertaken and published by large commercial concerns. Some years ago the scientific journals were concerned only with the researches of professors and their assistants in various technical colleges and independent chemists, but when the large manufacturers found it to their interest to establish laboratories and employ first-class chemists, a certain amount of research work began to be published which was of commercial origin. Of course many manufacturers, as now, forbade the publication of work done in their laboratories in case their rivals should be helped too much by it, but some were more public spirited, and now we think many are beginning to realise that to take the public into their confidence to some extent is a sure way of securing their support. We think that this form of commercial research has come to stay, and we therefore are sure that brewers will welcome this similar enterprise on the part of Messrs. Murphy and Son.

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